

**AMENDMENTS TO THE SPECIFICATION:**

Please replace the first full paragraph on page 2 of the substitute specification with the following amended paragraph:

In the case of the line converter of Patent Document 1, there is a need to form a penetrating groove in the dielectric substrate, so as to penetrate part of the waveguide tube divided into two parts. Therefore, when the dielectric substrate is formed as a ceramic substrate including ~~aluminum~~alumina or the like, it becomes difficult to machine the dielectric substrate. Further, coupling of the micro-strip line is achieved at a position where the intensity of electric fields generated by a standing wave generated at a terminal end of the waveguide is high. The coupling characteristic is determined by the positional relationship between the dielectric substrate including the micro-strip line and the waveguide tube. Therefore, the coupling characteristic is affected by the precision of assembling the dielectric substrate and the waveguide tube, which makes it difficult to obtain a line-conversion characteristic according to a predetermined design without variations.

Please replace the third and fourth full paragraphs on page 6 of the substitute specification with the following amended paragraphs:

Figs. 1(A)-1(C) show sectional views and a plan view of a line converter according to a first preferred embodiment of the present invention.

Figs. 2(A)-2(D) show exploded plan views illustrating the line converter.

Please replace the first and second full paragraphs on page 7 of the substitute specification with the following amended paragraphs:

Figs. 6(A)-6(C) illustrate a line converter according to a second preferred embodiment of the present invention.

Figs. 7(A)-7(D) show exploded plan views of the line converter.

Please replace the third full paragraph on page 8 of the substitute specification with the following amended paragraph:

A three-dimensional-waveguide groove G11 is provided on the lower conductor plate 1 (Fig. 2(D)) and a three-dimensional-waveguide groove G21 is provided on the upper conductor plate 2 (Fig. 2(A)). The lower dielectric strip 6 is inserted in the three-dimensional-waveguide groove G11 (Fig. 2(D)). The upper dielectric strip 7 is inserted in the three-dimensional-waveguide groove G21 (Fig. 2(A)). By overlaying the two conductor plates 1 and 2 one another, the two dielectric strips 6 and 7 are opposed to each other. Subsequently, a dielectric-filled waveguide (DFWG) (hereinafter simply referred to as a "waveguide") is formed.

Please replace the paragraph bridging pages 8 and 9 of the substitute specification with the following amended paragraph:

A predetermined plane of the waveguide is determined to be an E plane-~~E~~ (a conductor plane that is substantially parallel to the electric field of a TE<sub>10</sub> mode that is the mode of a propagating electromagnetic wave), where the E plane-~~E~~ is substantially parallel to the lower conductor plate 1 and the upper conductor plate 2. Therefore, the dielectric substrate 3 is provided at a position that is substantially parallel to the plane E of the waveguide and corresponding to the approximately central portion of the waveguide (the portion located between the lower conductor plate 1 and the upper conductor plate 2).

Please replace the first and second full paragraphs on page 9 of the substitute specification with the following amended paragraphs:

The conductor plates 1 and 2 are preferably formed by machining a metal plate including ~~aluminum~~-alumina or other suitable material, for example. Further, the dielectric strips 6 and 7 are preferably formed by injection-molding or machining a fluoroplastic resin, for example. The dielectric substrate 3 is preferably formed by using

a ceramic substrate including aluminum or other suitable material.

A transmission-line conductor 4a and a coupling-line conductor 4k continuing therefrom are provided on the undersurface of the dielectric substrate 3 (the side facing the lower conductor plate 1) (Fig. 2(C)). A ground conductor 5g is disposed on the top surface of the dielectric substrate 3 (the side facing the upper conductor plate 2) (Fig. 2(B)). The transmission-line conductor 4a located on the dielectric substrate 3 and the ground conductor 5g located on the surface facing the transmission-line conductor 4a define a micro-strip line.

Please replace the paragraph bridging pages 9 and 10 of the substitute specification with the following amended paragraph:

A notch portion is provided in the ground conductor 5g on the top surface of the dielectric substrate 3, as indicated by reference character N shown in Fig. 2(B). The coupling-line conductor 4k facing the notch portion N, the dielectric substrate 3, the lower conductor plate 1, and the upper conductor plate 2 define a suspended line. The transmission-line conductor 4a and the coupling-line conductor 4k are disposed on the undersurface-side of the dielectric substrate 3 and the ground conductor 4g (Fig. 2(C)) is located in a predetermined area that is spaced away from the transmission lines by as much as a predetermined distance.

Please replace the paragraph bridging pages 11 and 12 of the substitute specification with the following amended paragraph:

For sandwiching the dielectric substrate 3 having various conductor patterns disposed thereon between the two conductor plates 1 and 2 in the above-described manner, the dielectric substrate 3 is provided at a predetermined position with respect to the conductor plates 1 and 2 so that the coupling-line conductor 4k is inserted in the waveguide in a predetermined direction that is substantially perpendicular to the electromagnetic-propagation direction of the waveguide. The ground conductors 4g

and 5g are arranged on the dielectric substrate 3 so that a portion of each of the ground conductors 4g and 5g is inserted in the waveguide. As shown in Fig. 1, a portion of the ground conductors 4g and 5g is designated by reference character S. This portion defines a shield area of the waveguide. That is to say, by arranging a ground conductor substantially parallel to the E plane-E at the approximately central portion of the waveguide, the waveguide is divided by the plane that is substantially parallel to the E plane-E, whereby the shield wavelength of the waveguide is reduced and the shield area is located in the waveguide. Specifically, the portion designated by reference character S functions as a conductor portion defining the shield area included in preferred embodiments of the present invention.

Please replace the second full paragraph on page 13 of the substitute specification with the following amended paragraph:

The design circumstances are as follows, for example:

Frequency: 76-GHz band

Width of the three-dimensional waveguide grooves G11 and G21 (Fig. 1(C)):  $W_g$   
= about 1.2 mm

Depth of the three-dimensional waveguide grooves G11 and G21 (Fig. 1(A)):  $H_g$   
= about 0.9 mm

Dielectric constant of the dielectric strips 6 and 7: 2

Width of the dielectric strips 6 and 7 (Figs. 1(C)):  $W_d$  = about 1.1 mm

Height of the dielectric strips 6 and 7 (Fig. 1(A)):  $H_d$  = about 0.9 mm

Dielectric constant of the dielectric substrate 3 (Figs. 2(B) and 2(C)): 10

Thickness of the dielectric substrate 3 (Figs. 2(B) and 2(C)):  $t$  = about 0.2 mm

Line width of the transmission-line conductor 4a and the coupling-line conductor 4k (Figs. 2(C)):  $W_c$  = about 0.2 mm

Please replace the paragraph bridging pages 13 and 14 of the substitute specification with the following amended paragraph:

Fig. 3 shows the result of three-dimensional electromagnetic-field analysis simulation illustrating line conversion between the waveguide and the plane circuit. Further, Fig. 4 shows a cross-sectional view of the waveguide portion. In Fig. 3, white and periodically shown patterns indicate the electric-field intensity distribution. In Fig. 4, ring-like patterns indicate the electric-field-intensity distribution. When comparing Figs. 3, 4, 1(A), and 1(C) to one another, it is clear that the standing wave is generated by the waveguide-shield area defined by the conductor portion S and electromagnetically coupled to the suspended line defined by the coupled-connection conductor 4k at a position where the electric-field intensity of the standing wave increases to a maximum value. That is to say, a distance  $L_d$  (Fig. 4) between the conductor portion S defining the shield area and the coupling-line conductor 4k is determined so that the coupling-line conductor 4k is provided at a predetermined position where the electric-field distribution of the standing wave has a maximum value.

Please replace the second full paragraph on page 16 of the substitute specification with the following amended paragraph:

A three-dimensional-waveguide groove G11 is provided on the lower conductor plate 1 (Fig. 7(D)) and a three-dimensional-waveguide groove G21 is provided on the upper conductor plate 2 (Fig. 7(A)). By overlaying the two conductor plates 1 and 2 one another, the two three-dimensional-waveguide grooves are opposed to each other. Subsequently, the hollow rectangular waveguide tube (hereinafter simply referred to as a "waveguide tube") is formed.

Please replace the paragraph bridging pages 16 and 17 through the paragraph bridging pages 17 and 18 of the substitute specification with the following amended paragraphs:

A predetermined plane of the waveguide tube is determined to be an E-plane-E (a conductor plane that is substantially parallel to the electric field of a TE<sub>10</sub> mode that is the mode of a propagating electromagnetic wave), where the E-plane-E is substantially parallel to the lower conductor plate 1 and the upper conductor plate 2. Therefore, the dielectric substrate 3 is provided at a position that is substantially parallel to the E-plane-E of the waveguide tube and that corresponds to the approximately central portion of the waveguide tube (a portion between the lower conductor plate 1 and the upper conductor plate 2).

A transmission-line conductor 4a and a coupling-line conductor 4k continuing therefrom are disposed on the undersurface of the dielectric substrate 3 (the side facing the lower conductor plate 1) (Fig. 7(C)). A ground conductor 5g is disposed on the top surface of the dielectric substrate 3 (the side facing the upper conductor plate 2) (Fig. 7(B)). The transmission-line conductor 4a disposed on the dielectric substrate 3 and the ground conductor 5g disposed on the plane facing the transmission-line conductor 4a define a micro-strip line. In this preferred embodiment, the ground conductor 5g is provided only on the top-surface side of the dielectric substrate 3.

A notch portion is formed in the ground conductor 5g, as indicated by reference character N shown in Fig. 27(B). The coupling-line conductor 4k facing the notch portion N, the dielectric substrate 3, the lower conductor plate 1, and the upper conductor plate 2 define a suspended line.

When the dielectric substrate 3 is sandwiched between the two conductor plates 1 and 2, as is the case with the first preferred embodiment, the dielectric substrate 3 is provided at a predetermined position with reference to the conductor plates 1 and 2 so that the coupling-line conductor 4k is inserted in the waveguide in a predetermined direction that is substantially perpendicular to the electromagnetic-wave-propagation direction of the waveguide tube. At the same time, the dielectric substrate 3 is provided at a predetermined position so that the ground conductor 5g is inserted in the approximately central portion of the waveguide tube, so as to be substantially parallel to

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the E plane-E. A waveguide-shield area of the waveguide is defined by a predetermined portion designated by reference character S shown in Fig. 6 of the ground conductor 5g. The portion indicated by reference character S is a conductor portion defining the shield area.